

77. An ultrasonic catheter according to Claim 74 wherein the processor is coupled to a display wherein the two-dimensional image information acquired in step (1) and the component of motion determined in step (4) can be displayed.

78. An ultrasonic catheter according to Claim 74 wherein the processor is programmed to acquire two-dimensional image information with the second array and wherein the processor is coupled to a display wherein two-dimensional image information acquired from at least one of the first and second arrays can be displayed.

79. An ultrasonic catheter according to Claim 74 wherein the processor is coupled to a display and the processor is programmed to form a three-dimensional reconstruction and wherein the three-dimensional reconstruction is displayed.

80. An ultrasonic catheter according to Claim 1 wherein the first and second ultrasonic transducer arrays are coupled to a transmit beamformer and a receive beamformer, and a processor and a display are coupled to the transmit and receive beamformers, wherein the processor is programmed to (1) acquire two-dimensional image information in a first image plane generated by the first array upon excitation by the transmit beamformer, (2) acquire two-dimensional image information in a second image plane generated by the second array upon excitation by the transmit beamformer, and (3) selectively display the two-dimensional image information acquired from at least one of the first or second arrays. —

REMARKS

I. Summary:

The disclosure is objected to because of blank spaces found on page 8. Those blank spaces have been filled and thus the objection should be withdrawn. Claims 20 and 29 are rejected under 35 U.S.C. §112, second

paragraph. Claims 1 and 7 are rejected under 35 U.S.C. §102(e) as being anticipated by Hamilton et al. Claims 2-6, 8, 11-12, 16, 25-28, 32-45, 48-59, 68-69 and 72-73 are rejected under 35 U.S.C. §103(a) as being unpatentable over Hamilton et al. in view of Liang et al. Claims 17-24, 29-31, 46-47, 60-67 and 70-71 are rejected under U.S.C. §103(a) as being unpatentable over Hamilton et al. in view of Ueno et al., in further view of Yock and in further view of Tenhoff or Rosenfield et al.

II. Claims 20 and 29:

Claims 20 and 29 are rejected under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Applicant respectfully traverses this rejection. The term "automatically" is used to distinguish the claimed steps from systems in which the steps are performed manually.

III. Claims 1 and 7:

Claims 1 and 7 are rejected under 35 U.S.C. §102(e) as being anticipated by Hamilton et al. Applicants respectfully traverse this rejection.

Claim 1 calls for an ultrasonic catheter having a body, a first and a second ultrasonic transducer array disposed in a distal end region of the body. Claim 7 calls for an ultrasonic system including an ultrasonic catheter having a body, a first and second ultrasonic transducer array disposed in a distal end region of the body and a transmit and receive beamformer coupled to each of the first and second ultrasonic transducer arrays.

Hamilton et al. disclose an ultrasound system including one transducer array disposed in a distal end of a catheter. As shown in Figure 1, the transducer array is disposed around the circumference of the catheter. Hamilton et al. only provide one transducer array, whereas claims 1 and 7 call for two ultrasonic transducer arrays disposed in a distal end region of a catheter. For at least this reason, claims 1 and 7 are not anticipated by Hamilton et al. and the

Examiner is respectfully requested to withdraw the rejection.

IV. Claims 2-6, 8, 11-12, 16, 25-28, 32-45, 48-59, 68-69 and 72-73:

Claims 2-6, 8, 11-12, 16, 25-28, 32-45, 48-59, 68-69 and 72-73 are rejected under 35 U.S.C. §103(a) as being unpatentable over Hamilton et al. in view of Liang et al.

Claims 2-6, 8, 11-12, 16, 32-45, 48-59 and 72-73 are dependent either upon claim 1 or 7 and are thus patentable for at least the same reason already given with reference to claims 1 and 7. Claims 48-59 are dependent upon claim 46 which is dependent upon claim 17, both of which were not included in this rejection. Applicant believes that claims 48-59 should not have been included in this rejection since neither claim 17 or 46 was rejected on these grounds. Claim 25 calls for a method for imaging a cardiac structure by inserting a catheter having a first and second phased ultrasonic transducer array disposed in a distal end region, acquiring image information from the first phased ultrasonic array and acquiring image information from the second phased ultrasonic array. Claims 26-28 and 68-69 are dependent upon claim 25.

As already previously discussed, Hamilton et al. do not disclose two transducer arrays disposed in a distal end region of a catheter. Liang et al. disclose a forward looking ultrasonic imaging catheter that includes one or more transducers and an ultrasound mirror. A drive cable provides relative motion between the transducer and mirror. The Examiner states that Liang et al. disclose "that it is known to provide one or more transducers of different array configurations (column 3, line 35)," however, Applicants are unable to find such a teaching in Liang et al. Moreover, even if there was such a teaching in Liang et al, there is no suggestion to combine the teachings of Hamilton et al. and Liang et al. In fact, Hamilton et al. discourages such a combination. Hamilton et al. discloses at column 1, lines 12-23 that there are two distinct approaches to forming an image with an ultrasound transducer mounted at the tip of a catheter. The first approach is to provide a single rotating transducer and the second

approach is to use a multi-element transducer. Hamilton et al. is directed to the multi-element approach while Liang et al. is directed to the rotating transducer approach. Because Hamilton et al. and Liang are directed to two distinct approaches there is no reason to combine their teachings. For at least these reasons, claim 25 and claims 26-28, 68-69 which are dependent upon claim 25, are not rendered unpatentable in view of the cited art. The Examiner is respectfully requested to withdraw the rejection.

V. Claims 17-24, 29-31, 46-47, 60-67 and 70-71:

Claims 17-24, 29-31, 46-47, 60-67 and 70-71 are rejected under 35 U.S.C. §103(a) as being unpatentable over Hamilton et al., in view of Ueno et al., in further view of Yock and in further view of Tenhoff or Rosenfield et al.

Claims 17-19, 46-47 and 70 are dependent either upon claim 1 or 7 and thus are patentable for at least the same reason already given with reference to claims 1 and 7.

Claim 20 calls for a method for registering image information acquired from an interior region of a patient. The method comprising the steps of:

(a) inserting a catheter into a patient to image an interior region of the patient, the catheter having a body having a longitudinal axis, a circumference and a distal end region, a first ultrasonic transducer array disposed in the distal region of the body and a second phased ultrasonic transducer array disposed in the distal end region of the body;

(b) acquiring a plurality of sets of image data in an image plane with the first ultrasonic transducer array, the first ultrasonic transducer array moved between acquisition of at least some of the sets of image data;


(c) acquiring a plurality of sets of tracking data in a tracking plane oriented at a non-zero angle with respect to the image plane with the second ultrasonic transducer array, the second ultrasonic transducer array moved between acquisition of at least some of the sets of tracking data;

- (d) automatically determining a component of motion based on a comparison of at least a portion of the tracking sets acquired in step (c); and
- (e) automatically using the component of motion determined in step (d) to register select ones of the image data sets acquired in step (b).

Hamilton et al. do not disclose a catheter having multiple arrays as required by claim 20. Instead, Hamilton et al. disclose a radial array.

Ueno et al. and Yock, like Liang et al., are directed to the rotating transducer approach and thus would not be combinable with Hamilton et al. for the same reasons already explained with respect to Liang et al. In addition, Ueno et al. and Yock only discloses one transducer in the distal end of the catheter, and thus could not acquire the image data with a first ultrasonic transducer array and tracking data with a second ultrasonic transducer array. Moreover, Ueno et al. is specifically directed for performing a search based on correlation for no motion. There is no teaching or suggestion in Ueno et al. of motion estimation or 2D motion estimation. Neither Tenhoff nor Rosenfield et al. supplement the deficiencies of the other cited art, as called for by steps (b) and (c) of claim 20.

Respectfully submitted,


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